Technical Assistance Services *for* Communities

West Lake Landfill Superfund Site

Fact Sheet #2 - March 2014

Introduction

This fact sheet provides information about the general geology and ground water movement at the West Lake Landfill Superfund site in Bridgeton, Missouri. Additionally, it discusses sampling at the site and contaminant concentrations in ground water.

Background

West Lake Landfill is located in the St. Louis metropolitan area on the east side of the Missouri River. The 200-acre area is located about one mile north of the Interstate 70/270 interchange and four miles west of Lambert-St. Louis International Airport.

Limestone quarrying on site from 1939 until 1988 left behind two quarry pits. Beginning in the early 1950s, operators used parts of the quarried areas as a landfill for municipal, industrial and construction waste. Landfill operations ceased in 2005.

EPA divided the site into two areas, or operable units (OUs), for cleanup. OU1 addresses radiologically contaminated areas (Area 1 and Area 2). OU2 addresses other landfill areas, including the Bridgeton Sanitary Landfill. The remainder of this fact sheet focuses on OU1.

Cleanup

EPA selected the cleanup plan for radiologically contaminated areas at the site in 2008. EPA selected the remedy in a decision document called a Record of Decision, or ROD. The remedy included covering the landfill, monitoring ground water, controlling surface water runoff and monitoring landfill gas. The ROD also called for land and resource use controls, long-term surveillance and maintenance.

In May 2012, EPA directed OU1 Respondents (the potentially responsible party group) to perform four additional rounds of ground water sampling. The goal was to verify that current ground water conditions are consistent with ground water conditions identified in the site's remedial investigation completed in 2000. The fourth sampling event took place in October 2013.

What's Next?

EPA is reviewing data from the four ground water monitoring reports. Reports are available online at: http://www.epa.gov/region7/cleanup/west_lake_landfill/. The United States Geological Survey (USGS) is also assisting EPA with determining background levels for radioactive contaminants, as well as studying the site's complex geology and hydrogeology. New information regarding the status of the ground water is expected in the near future, and may inform how the site is cleaned up. To update the site's remedy, EPA would issue an additional decision document called a ROD Amendment.

Technical Assistance Services for Communities (TASC)

The Technical Assistance Services for Communities (TASC) contract provides EPA-funded technical support for communities living near hazardous waste sites. This support can include information assistance, community education and technical expertise. TASC is currently providing technical support to communities impacted by West Lake Landfill through the West Lake Landfill Community Advisory Group.

Site Geology

The site is geologically located at the intersection of the Missouri River floodplain (immediately to the west) and the loess bluffs to the east. An alluvium consisting of layers of fine-grained clay and silt over poorly sorted, coarse-grained sand and gravel is below the site. An alluvium is an area of material deposited over time by flowing water. Limestone bedrock is below the alluvium.

The depth of the alluvium is variable near the site. Alluvial thickness in the southeast part of Area 1 is less than 5 feet; it is about 80 feet thick at the northwest edge of Area 1. Alluvial deposits beneath Area 2 are fairly uniform at about 100 feet thick. Depth from the ground surface to the limestone bedrock near the landfill ranges from 14 to 110 feet.

Landfill Debris

Figures 1 and 2 present conceptual, cross-section pictures of the subsurfaces in Areas 1 and 2. Blue triangles represent ground water levels observed when soil borings were made. Some observed water may have been isolated perched water, not the water table.

Karst

Karst is a landscape formed when certain types of rocks dissolve, leaving a void where the rock once existed. These rocks include limestone, dolomite and gypsum. Karst is characterized by sinkholes, caves and underground drainage systems.

In Missouri, karst formations frequently affect the flow of ground water. However, no significant karst features have been identified at the site. Therefore, formation of sink holes or other significant subsurface changes due to weathering of underground rocks would not be expected in a geologically short timespan. Geological features and the general ground water flow direction are not likely to change much in the next 1,000 or so years.

Figure 1: Illustrated Cross-section of Area 1

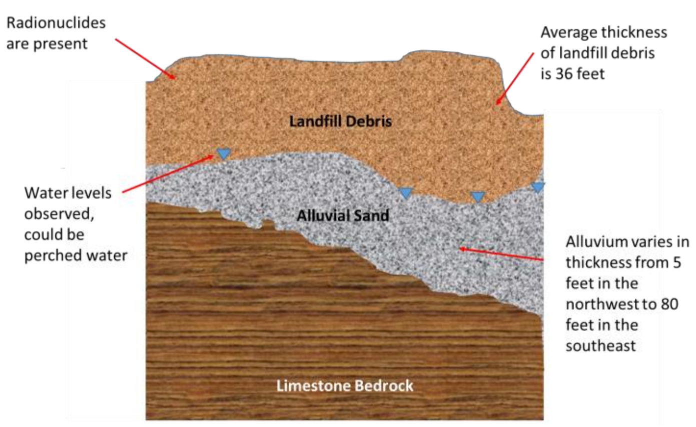
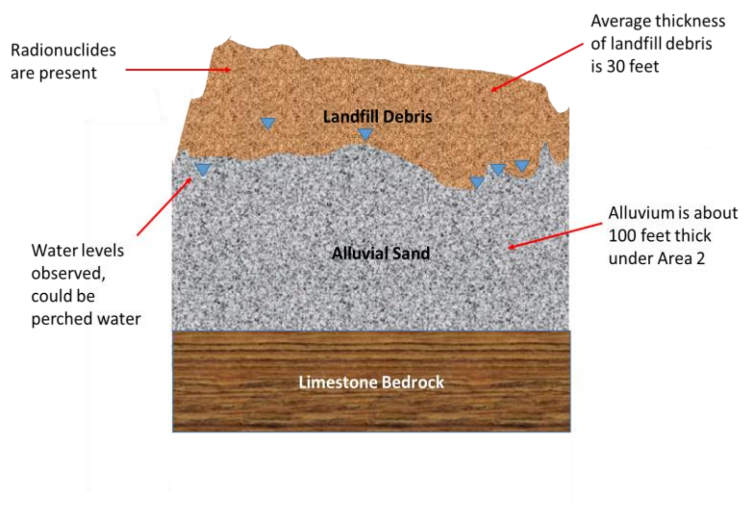


Figure 2: Illustrated Cross-section of Area 2



Ground Water

Studies during the site's remedial investigation in the 1990s and subsequent ground water sampling in 2012 and 2013 provide information about ground water in the vicinity of the site.

Ground water is present in perched water, an alluvium aquifer and a bedrock aquifer. Perched ground water is an area of ground water higher in elevation (closer to the ground surface) than the local or regional ground water table. Perched water occurs when specific conditions slow down or prevent rainwater from percolating all the way to the lower water table, such as a localized area of clay. The remedial investigation found perched water in small isolated units at depths of 5 to 30 feet below ground surface within the landfill debris of Areas 1 and 2. Perched water in the landfill debris is similar in chemistry to landfill leachate.

The bedrock and alluvium aquifers at the site appear to be well connected, allowing ground water to pass from one to the other.

In areas next to the landfill, ground water is generally 15 to 20 feet below ground surface. Beneath the landfill, ground water varied in depth from 20 to 60 feet below ground surface. This increase in depth to water is the result of the increased height of the surface of the landfill, which is 10 to 30 feet above the ground surface of adjacent areas. The remedial investigation found that the lowest ground water levels occurred during fall and winter months (September through March). The highest levels occurred during spring and summer months (April through August). This is expected due to seasonal variations in precipitation.

Ground Water Flow

The general direction of alluvial ground water flow near the site is to the northwest, toward the Missouri River. However, there can be localized variations in the direction of ground water flow. For example, the remedial investigation found that ground water flow beneath radiological Area 1 appears to occur primarily in a southern direction, toward the Bridgeton Landfill. Pumping of leachate from the Bridgeton landfill likely affects the direction of ground water flow near the leachate extraction well.

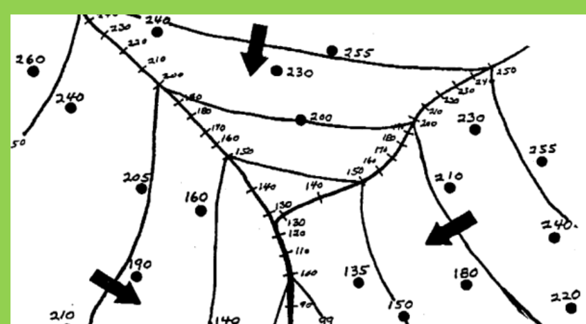
The water table beneath the landfill is rather flat, which makes exact determination of the direction of localized ground water flow difficult.

Measuring Ground Water Flow

Ground water moves from high areas to low areas in the same manner that streams and rivers flow, except that it travels more slowly. If the soil is mostly sand and gravel, ground water can move as much as five feet per day. At the site, ground water flow was measured in the range of 0.003 to 0.4 feet per day (less than 150 feet per year).

Ground water follows the path of least resistance "downhill" due to gravity unless it is affected by some other force. For example, ground water extraction wells can have an effect on localized ground water flow, causing the path of least resistance to be toward the extraction well.

Water table contour maps are made by measuring the height of ground water in ground water monitoring wells. Ground water flows in a perpendicular direction (at a 90 degree angle) to the water table contour lines, as shown by the arrows in the picture below.



Ground Water Monitoring

Ground water sampling started at the site in 1980. Sampling events and results are summarized below. Sampling results do not indicate the presence of any continuous plume of contaminated ground water that may be moving off site. Contaminants found in ground water at levels above their respective EPA health-based maximum contaminant level (MCL) for drinking water are arsenic, benzene, chlorobenzene, radium-226 + radium-228, uranium and vinyl chloride. The ground water is not being used as a drinking water source.

EPA collects both filtered and unfiltered ground water samples. An unfiltered sample measures the contaminants in both sediment and water. A filtered sample filters out the sediment and only measures contaminants that are dissolved in water. The mobility of radionuclides in water is controlled by environmental conditions, as well as by the nature of the radionuclide.

Nuclear Regulatory Commission Investigation

In the 1980s, sampling was conducted to identify ground water alpha or beta activity, an indicator of the presence of radioactive materials. An environmental consulting firm concluded that none of the ground water samples contained alpha activity above EPA guidelines for drinking water. The team determined that beta activity was caused by potassium-40, a naturally occurring radioactive element. The consultant concluded that: "These results indicate that the buried ore residues are probably not soluble and are not moving off-site via ground water."

Remedial Investigation (RI)

In the 1990s, ground water sampling was conducted to investigate site contamination. An environmental contractor sampled ground water five times between 1995 and 1997 for radiological and non-radiological contaminants. One set of samples was analyzed for radium-226 + radium 228 to compare to the drinking water MCL. Arsenic in concentrations above its current MCL was detected in about half the wells sampled. Other contaminants detected at levels above their MCL included benzene in three wells, chlorobenzene in up to four wells, and radium-226 + radium-228 in one well. The RI Report concluded that ground water transport did not represent a significant pathway for radionuclide migration from OU1.

For More Information

EPA West Lake Landfill website:
http://www.epa.gov/region07/cleanup/west_lake_landfill/index.htm

Missouri Department of Natural Resources (MDNR) West Lake Landfill website:
http://dnr.mo.gov/env/hwp/fedfac/westlakelandfill-ffs.htm

MDNR Bridgeton Sanitary Landfill website:
http://www.dnr.mo.gov/Bridgeton

Republic Services Bridgeton Sanitary Landfill website:
http://www.bridgetonlandfill.com

Additional Ground Water Sampling

In 2010, EPA decided to require additional ground water sampling in August 2012, April 2013, July 2013 and October 2013. Seventy-three (73) monitoring wells were sampled in 2012, 75 wells were sampled in April and July 2013, and 84 wells were sampled in October 2013. Additional wells were added to ground water sampling events to gain a better understanding of the impact of the site on ground water. Exceedances of MCLs of specific compounds are shown in Table 1 on page 5. Thorium does not have an MCL, so 1 pCi/L was used arbitrarily as a cutoff point for information in Table 1. MCLs are drinking water standards.

Radium

Radium has the strictest drinking water standard compared to other radionuclides. The highest level of dissolved radium (Ra-226 + Ra-228) was detected in bedrock monitoring well PZ-101-SS for each of the four sampling events. Although ground water monitoring reports refer to this well as an "upgradient" well, ground water elevation data in the reports indicate that ground water from Area 1 may sometimes flow toward PZ-101-SS. Location of wells where dissolved radium exceeded the MCL are shown in Figure 3 on page 6. The chemistry of radium resembles the chemistry of barium. Radium sulfate is nearly insoluble in water (it does not dissolve very much). However, radium does form water-soluble chloride, bromide and nitrate salts. Phosphate, carbonate, selenate, fluoride and oxalate salts of radium are only slightly soluble in water.

Table 1: Summary of 2012/2013 Ground Water Sampling Results

	Contaminant	EPA MCL*	Number of Wells with Concentrations at or above the MCL				Sources
			August 2012	April 2013	July 2013	October 2013	
Radionuclides	Radium-226 +228	5 picocurie per liter (pCi/L)	25 unfiltered 20 filtered	19 unfiltered 8 filtered	20 unfiltered 18 filtered	26 unfiltered 18 filtered	Naturally occurring in rocks; uranium mine and process wastes
Radionuclides	Thorium	No MCL, used 1 pCi/L as a cutoff	19 unfiltered 4 filtered	13 unfiltered 0 filtered	17 unfiltered 1 filtered	16 unfiltered 4 filtered	Naturally occurring in rocks; uranium mine and process wastes
Radionuclides	Uranium	30 micrograms per liter (µg/L)	0	1 unfiltered	0	1 unfiltered	Naturally occurring in rocks; uranium mine and process wastes
Trace Metals	Arsenic	10 µg/L	24 unfiltered 13 filtered	15 unfiltered 15 filtered	29 unfiltered 24 filtered	25 unfiltered 20 filtered (1)**	Naturally occurring in rocks; pesticide-treated wood
Volatile Organic Compounds (VOCs)	Benzene	5 µg/L	9	11	14	17	Gasoline; petroleum products; solvents
Volatile Organic Compounds (VOCs)	Chlorobenzene	100 µg/L	2	2	1	1 (1)**	Solvents; degreasing products
Volatile Organic Compounds (VOCs)	Vinyl Chloride	2 µg/L	2	3	2	2 (2)**	Decomposition of PCE, a dry-cleaning fluid; PVC products

* The EPA MCL is a health based regulatory standard for drinking water.
**The number in parethesis is the number of wells where the laboratory did not find the contaminant in the sample, but the laboratory's minimum detection limit was greater than EPA's MCL for drinking water.

Uranium

Uranium is not very soluble in water and is less soluble under reducing conditions typically found in landfills. It is more soluble in oxidizing conditions (high dissolved oxygen), regardless of the pH (acidity) of the water.

Thorium

Overall, only low levels (less than 1 pCi/L) of thorium isotopes were detected in the majority of the wells. There are no federal or state drinking water or other water quality standards for any of the thorium isotopes or total thorium. The highest level of total thorium (58.6 pCi/L) was found in an unfiltered sample from well S-53 in April 2013. Dissolved thorium from the same well in April 2013 was only 0.09 pCi/L. This well had not been sampled in a few years and the unfiltered sample had a lot of suspended sediment in it, likely affecting the results. Thorium is less soluble than uranium under all conditions. However, thorium in soil can be mobilized under low-pH (acidic) conditions. Ground water pH at the site is not low.

Trace Metals

The ground water samples were analyzed for 19 trace metals. The most frequently detected trace metals were iron and manganese, which were detected in nearly all of the monitoring wells. Nearly all of the iron and manganese results exceeded secondary drinking water standards based on aesthetic considerations (taste and color). The majority of detected arsenic results exceeded the MCL of 10 µg/l. Landfill conditions often cause these metals to become more soluble.

Volatile Organic Compounds (VOCs)

The groundwater samples were also analyzed for VOCs. Although many VOCs were detected, only benzene, chlorobenzene and vinyl chloride were found in concentrations exceeding their respective MCL. The most commonly detected VOC was benzene.

Figure 3: Dissolved Radium Exceedances of MCLs during 2012 and 2013 Sampling Events